FOOD AND DIURNAL BEHAVIOUR OF DEEPWATER PRAWNS

Penaeidean and caridean prawns provide most of the crustacean catch in a demersal trawl fishery for prawns and scampi on the North West Slope of Australia. The main penaeidean prawns are *Aristaeomorpha foliacea*, *Aristeus virilis*, *Haliporoides sibogae* and *Plesiopenaeus edwardsianus*, and the main caridean prawns are *Heterocarpus sibogae* and *H. woodmasoni*. Catch rates of all six prawn species are greater during the day than at night.

Foregut contents in trawl-caught prawns were analysed, and broad dietary groups used to indicate the habitats in which the prawns were feeding. Prey groups considered to indicate midwater feeding included siphonophores, chaetognaths, heteropods and pteropods; prey groups indicating benthic feeding included sponges, polychaetes, bivalves and echinoderms. In all prawn species, the majority of the foregut contents consisted of decapod crustaceans and fish, most of which was unidentifiable or was not classifiable as necessarily having a midwater or demersal origin. Significant quantities of foraminiferans and squid were also ingested.

Aristeus virilis, *Haliporoides sibogae* and *Plesiopenaeus edwardsianus*, which are mainly benthic or demersal animals, had mean catch rates between 1.4 and 2.0 times greater during the day than at night. *Aristaeomorpha foliacea* and *Heterocarpus sibogae*, which are both midwater and demersal animals, and *Heterocarpus woodmasoni*, which are mainly midwater animals, had mean catch rates between 2.6 and 16.5 times higher during the day than at night. Decreased catch rates of these species probably reflect nocturnal migration into midwater. Catch rates of *A. foliacea* peaked around mid-day, suggesting that a substantial proportion of the population may still be in midwater during daylight hours. Catch rates of *Heterocarpus sibogae* and *H. woodmasoni* varied little during daylight hours but changed rapidly around dawn and dusk, suggesting that their diurnal behaviour is strongly dependent on ambient light levels. Studies on midwater populations are proposed to determine the importance of midwater feeding in the diurnally migratory prawn species.

S.F. Rainer, CSIRO Marine Laboratories, P.O Box 20, North Beach, Western Australia 6020, Australia.

MICROPROCESSORS AND FIELD INSTRUMENTATION FOR CRUSTACEAN BIOLOGY

Micropower microprocessors are making possible the gathering of data, and its transmission, from situations where direct observation is either impossible or would influence the phenomena under study. This paper proposes two examples of field instrumentation, designed around microprocessors, which will address otherwise retractory questions in two areas of crustacean biology: larval transport/recruitment, and behavioural-physiological ecology.

The highest mortality in life cycles of marine Crustacea occurs during planktonic larval stage, yet little is understood about the phenomena that control mortality, transport, dispersion, and especially eventual recruitment. Experimental testing of hypotheses is made difficult by the minute size of the dispersing larval stages. Sampling of either the larvae themselves, or of the current regimes they would encounter as they migrate vertically, at the relevant spatial scale, is prohibitive. The Lagrangian approach requires intensive sampling from many vessels, with subsequent sorting of high numbers of plankton samples, the Eulerian approach demands unreasonable numbers of current meters.

To experimentally test theories of larval transport and recruitment, we are developing a microprocessor-controlled Lagrangian drifter that behaves like a larva but can be tracked remotely. A buoyancy adjustor under microprocessor control will allow the device to mimic larval behaviour, relevant to the species under study, in response to time, depth and other environmental cues, e.g. temperature, light, salinity. Initially these buoys will be programmed to mimic larvae of *Rhithropanopeus harrisii* and *Callinectes sapidus*, based on behaviours observed in laboratory and field, and used to examine how those behaviours contribute to retention in estuaries (*R. harrisii*) or export to continental shelf waters with subsequent re-invasion of estuaries (*C. sapidus*). A similar approach is applicable to replenishment of benthic faunas on isolated islands. The devices could also be programmed with hypothetical behaviours to examine the consequences of such behaviours for transport in various natural hydrographic regimes.

Another difficult area for study is the physiological and behavioural ecology of species inhabiting estuaries. Direct observation by divers is difficult and often impossible because the subjects are highly mobile, and live under very turbid conditions. Laboratory observations cannot be relied upon to provide relevant behavioral data, particularly for species that range over spatial scales orders of magnitude larger than the laboratory can accommodate.

To relay complex behavioural data from unrestrained animals in natural environments, we have designed microprocessor-based multichannel ultrasonic biotelemetry transmitters. The devices monitor up to eight different phenomena (e.g., muscle potentials, limb positions). At any change of input state, the microprocessor awakens and transmits the current state of its inputs, thus marking the beginning and end of an event at any input. The information is encoded either as pulse width, or as a frequency-shift-keyed (FSK) serial data word. All ultrasonic frequencies are synthesised by the microprocessor, which also drives the piezoelectric transducer directly. Power consumption is held to levels supportable with small batteries by operating the microprocessor with low duty cycles, putting it into 'sleep' (power down) mode when idle. The initial application of these transmitters will be to explore predator-prey and predator-predator interactions among *C. sapidus* and prey patches of small clams in Chesapeake Bay.

Acknowledgements

This research is being supported by grants OCE 8900060 and OCE 9002168 from the U.S. National Science Foundation.

T.G. Wolcott and D.L. Wolcott, Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, NC 27695, USA.